THE 3.4 MICRON EMISSION IN COMETS

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Emission features near 3.4 μm were detected in comet Bradfield (1987s) on 17 Nov 1987 UT, and, marginally, on two earlier dates, with the Cooled Grating Array Spectrometer at the NASA IRTF (Brooke et al., 1988b). The central wavelength (3.36 μm) and width (~0.15 μm) of the strongest feature coincide with those observed in comet Halley. A weaker emission feature at 3.52 μm and a strong feature extending shortward of 2.9 μm were also detected. This brings the number of comets in which these three features have been seen to three, two new (Bradfield, Wilson) and one old (Halley).

It seems almost certain that the 3.4 μm features are emissions by C-H groups in complex molecules. Based on the similarity of the 3.4 μm features in comets Halley and Wilson, we suggested that a particular set of organic compounds may be common to all comets (Brooke et al. 1988a). The absence of the feature in some comets could then be due to photodestruction or evaporation of the organics when the comet approaches the sun, in combination with a predominance of thermal emission from non C-H emitting grains. Detection of the 3.4 μm emission feature in comet Bradfield at r = 0.9 AU provides support for this argument.

Complex organics in comets could have been formed by particle irradiation of parent ices in the nucleus or been incorporated as grains at the time the comets formed. Since the most heavily irradiated layers of Halley would have been lost in its hundreds of perihelion passages, we believe the more likely explanation is that the 3.4 μm emitting material was incorporated in comet nuclei at the time of formation.

The 3.4 μm comet feature resembles, but is not identical to, the interstellar 3.29 μm (and longer wavelength) emission features and the broad 3.4 μm feature seen in absorption toward the Galactic center. Detailed comparisons of cometary and interstellar organics will require comet spectra with signal-to-noise and spectral resolution comparable to that available in spectra of the interstellar medium. Such observations are currently being planned.

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